



MEMORANDUM

TO: Ethyl Corporation HiTEC 3000 Team

FROM: Alison Pollack

DATE: 3 April 1990

SUBJECT: HiTEC 3000 Analyses related to Clean Air Act

This memo describes proposed statistical analyses to be incorporated into Ethyl's HiTEC 3000 waiver application Appendix on Clean Air Act issues.

Revised Standards

We will perform a subset of the nine EPA statistical tests using the five vehicular models that, on average, pass the current 50K 0.41g/mi hydrocarbon standard -- Models C, E, G, H, and I. The standards to be addressed, as listed in Jeff Smith's 7 March 1990 memo, are:

	<u>50,000 Miles</u>	<u>75,000 Miles</u>
Total hydrocarbon (THC)	0.31	0.39
Non-methane hydrocarbon (NMHC)	0.25	0.31
Carbon monoxide	3.4	4.2
Oxides of nitrogen	0.4	0.5

Proposed Statistical Tests

Only three of the nine EPA statistical tests address violations of the standard. These are the violation mileage test, the maximum percent of vehicles failing the standard test, and the cause or contribute test, all of which are based upon regression fits to the data. We propose to perform each of these three tests for each of the three pollutants. For the 50,000 standards, we will perform the tests using both linear and quadratic regression fits; for the 75,000 mile standards we will base the tests upon quadratic regression alone.

akp9764

Methane Proportions

Most cars were rated for methane at 50,000 miles; typically duplicate ratings were performed. Model G, however, had no methane ratings at 50,000 miles and Model C methane ratings at 50,000 miles were not performed in duplicate. Because the only methane ratings we have are at 50,000 miles (except for one car for each model group and fuel combination at 75,000 miles) we must assume that the methane fraction does not vary by mileage. To estimate NMHC emission rates, then, two approaches are obvious. The first is to use the car-specific methane proportions, and the second is to use an average methane proportion across the three cars for each fuel within each model group. Since the first approach requires more programming and hence more time, and because it seems reasonable to assume one methane proportion for each fuel/model group combination, we recommend the second approach.

Don Hollrah has already compiled tables of the methane ratings, which he faxed to me yesterday afternoon, for Models C, E, G, and H. For each test, Don calculated the methane percent, then averaged these percents across all three cars for each fuel for each model group. I recommend a slight variation on Don's calculations. Rather than estimate the average methane percent as the average of each of the methane/total hydrocarbon ratios, I suggest the ratio of the average methane rating to the average total hydrocarbon rating. The ratio of the averages is a more precise estimate than the average of the ratios. The results are shown in the table below. The last line in the table, the average across the four model groups, is also calculated as the ratio of the averages rather than the average of the ratios. We suggest using these averages (one per fuel) to represent the methane proportions for Model G.

<u>Model</u>	<u>EEE</u>			<u>HiTEC 3000</u>		
	<u>NMHC</u>	<u>THC</u>	<u>% Methane</u>	<u>NMHC</u>	<u>THC</u>	<u>% Methane</u>
C	.155	.181	14.0	.177	.202	12.5
E	.187	.218	14.1	.181	.210	13.8
H	.421	.482	12.6	.466	.535	13.0
I	.178	.209	14.9	.215	.249	13.5
Average	.235	.273	13.6	.260	.299	13.2

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000

Based on the five models that, on average, pass the current 50K .41 g/mi hydrocarbon standard

Data Set: ETHYL4S2

Pollutant: Hydrocarbons

OBSERVED INTEGRATED EMISSIONS PER MILE

Beginning Mileage	Ending Mileage	Scaling	Mean Integrated Emissions (a)		HiTEC 3000 Effect (b) (g/mi)
			HiTEC 3000 (g/mi)	EEE (g/mi)	
1,000	50,000	Unscaled	0.217	0.204	0.013
1,000	50,000	Scaled (c)	0.223	0.204	0.019
50,000	75,000	Unscaled	0.284	0.264	0.020
50,000	75,000	Scaled (c)	0.290	0.264	0.026
1,000	75,000	Unscaled	0.239	0.224	0.015
1,000	75,000	Scaled (c)	0.245	0.224	0.021

OBSERVED MEAN EMISSIONS

Mileage	Scaling	Weighted Average Emissions (d)		HiTEC 3000 Effect (b) (g/mi)
		HiTEC 3000 (g/mi)	EEE (g/mi)	
25,000	Unscaled	0.215	0.217	-0.003
25,000	Scaled (c)	0.221	0.217	0.003
50,000	Unscaled	0.242	0.239	0.004
50,000	Scaled (c)	0.248	0.239	0.009
75,000	Unscaled	0.288	0.265	0.023
75,000	Scaled (c)	0.294	0.265	0.029
1,000	Unscaled	0.144	0.149	-0.006

Notes

- For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
- These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
- The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
- Each figure is the mean of the car-means at the given mileage.

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000

Based on the five models that, on average, pass the current 50K .41 g/mi hydrocarbon standard

Data Set: ETHYL4S2

Pollutant: Carbon Monoxide

OBSERVED INTEGRATED EMISSIONS PER MILE

Beginning Mileage	Ending Mileage	Scaling	Mean Integrated Emissions (a)		HiTEC 3000 Effect (b) (g/mi)
			HiTEC 3000 (g/mi)	EEE (g/mi)	
1,000	50,000	Unscaled	2.89	2.91	-0.02
1,000	50,000	Scaled (c)	2.89	2.91	-0.02
50,000	75,000	Unscaled	3.72	3.93	-0.21
50,000	75,000	Scaled (c)	3.71	3.93	-0.21
1,000	75,000	Unscaled	3.17	3.25	-0.08
1,000	75,000	Scaled (c)	3.17	3.25	-0.09

OBSERVED MEAN EMISSIONS

Mileage	Scaling	Weighted Average Emissions (d)		HiTEC 3000 Effect (b) (g/mi)
		HiTEC 3000 (g/mi)	EEE (g/mi)	
25,000	Unscaled	3.01	3.17	-0.16
25,000	Scaled (c)	3.01	3.17	-0.16
50,000	Unscaled	3.45	3.77	-0.31
50,000	Scaled (c)	3.45	3.77	-0.31
75,000	Unscaled	3.66	3.75	-0.09
75,000	Scaled (c)	3.66	3.75	-0.09
1,000	Unscaled	1.48	1.48	0.00

Notes

- For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
- These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
- The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
- Each figure is the mean of the car-means at the given mileage.

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000

Based on the five models that, on average, pass the current 50K .41g/mi hydrocarbon standard

Data Set: ETHYL4S2

Pollutant: Nitrogen Oxides

OBSERVED INTEGRATED EMISSIONS PER MILE

<u>Beginning Mileage</u>	<u>Ending Mileage</u>	<u>Scaling</u>	<u>Mean Integrated Emissions (a)</u>		<u>HiTEC 3000 Effect (b) (g/mi)</u>
			<u>HiTEC 3000 (g/mi)</u>	<u>EEE (g/mi)</u>	
1,000	50,000	Unscaled	0.37	0.38	-0.01
1,000	50,000	Scaled (c)	0.34	0.38	-0.04
50,000	75,000	Unscaled	0.36	0.49	-0.13
50,000	75,000	Scaled (c)	0.33	0.49	-0.16
1,000	75,000	Unscaled	0.37	0.42	-0.05
1,000	75,000	Scaled (c)	0.34	0.42	-0.08

OBSERVED MEAN EMISSIONS

<u>Mileage</u>	<u>Scaling</u>	<u>Weighted Average Emissions (d)</u>		<u>HiTEC 3000 Effect (b) (g/mi)</u>
		<u>HiTEC 3000 (g/mi)</u>	<u>EEE (g/mi)</u>	
25,000	Unscaled	0.45	0.44	0.01
25,000	Scaled (c)	0.42	0.44	-0.02
50,000	Unscaled	0.36	0.44	-0.08
50,000	Scaled (c)	0.33	0.44	-0.11
75,000	Unscaled	0.38	0.52	-0.14
75,000	Scaled (c)	0.35	0.52	-0.17
1,000	Unscaled	0.26	0.23	0.03

Notes

- For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
- These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
- The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
- Each figure is the mean of the car-means at the given mileage.

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Mean Effects of HiTEC 3000

Based on the five models that, on average, pass the current 50K .41 g/mi hydrocarbon standard

Data Set: ETHYL4S2

Pollutant: Non-Methane Hydrocarbons

OBSERVED INTEGRATED EMISSIONS PER MILE

Beginning Mileage	Ending Mileage	Scaling	Mean Integrated Emissions (a)		HiTEC 3000 Effect (b) (g/mi)
			HiTEC 3000 (g/mi)	EEE (g/mi)	
1,000	50,000	Unscaled	0.188	0.176	0.012
1,000	50,000	Scaled (c)	0.193	0.176	0.017
50,000	75,000	Unscaled	0.246	0.229	0.018
50,000	75,000	Scaled (c)	0.251	0.229	0.022
1,000	75,000	Unscaled	0.208	0.194	0.014
1,000	75,000	Scaled (c)	0.212	0.194	0.018

OBSERVED MEAN EMISSIONS

Mileage	Scaling	Weighted Average Emissions (d)		HiTEC 3000 Effect (b) (g/mi)
		HiTEC 3000 (g/mi)	EEE (g/mi)	
25,000	Unscaled	0.187	0.188	-0.001
25,000	Scaled (c)	0.191	0.188	0.003
50,000	Unscaled	0.211	0.207	0.004
50,000	Scaled (c)	0.215	0.207	0.008
75,000	Unscaled	0.250	0.229	0.020
75,000	Scaled (c)	0.254	0.229	0.025
1,000	Unscaled	0.125	0.129	-0.004

Notes

- For each car, the emissions are integrated from the beginning mileage to the ending mileage and expressed as a rate in g/mi. Each figure is the mean of the car rates, weighting models by 1988 sales.
- These numbers give the average difference in emissions (HiTEC 3000 minus EEE).
- The HiTEC 3000 emissions are rescaled by subtraction of the initial difference between HiTEC 3000 and EEE, given in the final row of the table.
- Each figure is the mean of the car-means at the given mileage.

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
 Using Proposed Clean Air Act Standards
 50,000 Mile Analysis
 (based on linear regression)
 Data Set ETHYL4S2
 Pollutant Hydrocarbons

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	38,377	37,960	+
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
 Using Proposed Clean Air Act Standards
 50,000 Mile Analysis
 (based on linear regression)
 Data Set ETHYL4S2
 Pollutant Non-Methane Hydrocarbons

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	30,746	31,158	-
I	99,000	99,000	0

EPA Sign Test: Observation of 0 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	36,928	39,621	-
C	36,248	99,000	-
G	40,425	45,181	-
H	31,353	0	+
I	25,599	45,553	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	13,911	2,397	+
C	99,000	49,381	+
G	99,000	99,000	0
H	28,463	33,236	-
I	99,000	99,000	0

EPA Sign Test: Observation of 2 '+' sign(s) in 3 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the linear regression line) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression line lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	37,308	37,350	-
I	99,000	99,000	0

EPA Sign Test: Observation of 0 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	27,673	29,426	-
I	99,000	99,000	0

EPA Sign Test: Observation of 0 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	35,569	38,673	-
C	35,290	99,000	-
G	21,573	25,749	-
H	27,122	0	+
I	17,712	24,767	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test Using Proposed Clean Air Act Standards 50,000 Mile Analysis (based on quadratic regression) Data Set ETHYL4S2 Pollutant Carbon Monoxide

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	14,470	5,831	+
C	99,000	99,000	0
G	99,000	99,000	0
H	24,351	30,815	-
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	62,714	54,345	+
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	99,000	99,000	0
C	99,000	99,000	0
G	99,000	99,000	0
H	48,757	45,254	+
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 1 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test Using Proposed Clean Air Act Standards 75,000 Mile Analysis (based on quadratic regression) Data Set ETHYL4S2 Pollutant Nitrogen Oxides

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	67,904	99,000	-
C	50,126	99,000	-
G	99,000	99,000	0
H	99,000	99,000	0
I	55,783	99,000	-

EPA Sign Test: Observation of 0 '+' sign(s) in 3 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 100.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Violation Mileage Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Violation Mileage(a) (miles)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	21,623	14,665	+
C	99,000	99,000	0
G	99,000	99,000	0
H	39,022	48,258	-
I	99,000	99,000	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trial(s) rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- The violation mileage is the mileage (fitted by the quadratic regression curve) at which the standard is reached. Violation mileage = 0 if the zero mile emissions exceed the standard. Violation mileage = 99,000 if the regression curve lies entirely below the standard between 0 and 75,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	0.13 (50,000)	0.15 (50,000)	+
C	0.01 (50,000)	2.87 (50,000)	+
G	0.00 (50,000)	0.00 (50,000)	0
H	83.91 (50,000)	86.17 (50,000)	+
I	0.00 (50,000)	0.00 (50,000)	0

EPA Sign Test: Observation of 3 '+' sign(s) in 3 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 12.50 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	0.84 (50,000)	0.99 (50,000)	+
C	0.11 (50,000)	13.44 (50,000)	+
G	0.00 (50,000)	0.00 (50,000)	0
H	95.01 (50,000)	95.55 (50,000)	+
I	0.00 (50,000)	0.06 (50,000)	+

EPA Sign Test: Observation of 4 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 6.25 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
 Using Proposed Clean Air Act Standards
 50,000 Mile Analysis
 (based on linear regression)
 Data Set ETHYL4S2
 Pollutant Nitrogen Oxides

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+'= adverse HT3 effect)
	EEE	HT3	
E	82.06 (50,000)	76.85 (50,000)	-
C	83.42 (50,000)	14.19 (50,000)	-
G	66.48 (50,000)	57.16 (50,000)	-
H	60.44 (50,000)	73.26 (0)	+
I	77.46 (50,000)	53.57 (50,000)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b).
 (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
 Using Proposed Clean Air Act Standards
 50,000 Mile Analysis
 (based on linear regression)
 Data Set ETHYL4S2
 Pollutant Carbon Monoxide

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	100.00 (50,000)	100.00 (50,000)	0
C	31.69 (50,000)	51.38 (50,000)	+
G	0.09 (50,000)	0.07 (50,000)	-
H	99.58 (50,000)	97.80 (50,000)	-
I	4.02 (50,000)	1.84 (50,000)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 93.75 percent significance level(b).
 (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the linear regression line. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs and is 0 if the slope is negative and 50,000 if the slope is positive.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
 Using Proposed Clean Air Act Standards
 50,000 Mile Analysis
 (based on quadratic regression)
 Data Set ETHYL4S2
 Pollutant Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	0.10 (50,000)	0.02 (35,088)	-
C	0.00 (36,380)	0.31 (35,370)	+
G	0.00 (32,918)	0.00 (33,607)	0
H	70.19 (50,000)	78.79 (50,000)	+
I	0.00 (31,929)	0.00 (34,874)	0

EPA Sign Test: Observation of 2 '+' sign(s) in 3 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 50.00 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	0.75 (50,000)	0.21 (35,088)	-
C	0.01 (36,380)	3.27 (35,370)	+
G	0.00 (32,918)	0.00 (33,607)	0
H	88.48 (50,000)	92.31 (50,000)	+
I	0.00 (31,929)	0.03 (34,874)	+

EPA Sign Test: Observation of 3 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 31.25 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards

50,000 Mile Analysis
(based on quadratic regression)

Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	73.43 (50,000)	55.44 (47,899)	-
C	77.86 (50,000)	8.98 (38,471)	-
G	69.67 (30,815)	55.36 (30,971)	-
H	56.33 (50,000)	70.29 (17,570)	+
I	69.36 (36,054)	52.71 (30,727)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards

50,000 Mile Analysis
(based on quadratic regression)

Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	100.00 (50,000)	99.96 (46,160)	-
C	15.16 (37,440)	28.41 (41,307)	+
G	0.00 (39,985)	0.00 (33,786)	0
H	97.22 (50,000)	93.73 (50,000)	-
I	1.10 (42,930)	0.61 (35,336)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 93.75 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 50,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards

75,000 Mile Analysis
(based on quadratic regression)

Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	0.19 (75,000)	0.04 (75,000)	-
C	0.00 (60,309)	0.00 (49,479)	0
G	0.00 (75,000)	0.00 (57,308)	0
H	68.45 (75,000)	91.52 (75,000)	+
I	0.00 (75,000)	0.00 (75,000)	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
 Using Proposed Clean Air Act Standards
 75,000 Mile Analysis
 (based on quadratic regression)
 Data Set ETHYL4S2
 Pollutant Non-Methane Hydrocarbons

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	1.26 (75,000)	0.36 (75,000)	-
C	0.00 (60,309)	0.00 (49,479)	0
G	0.00 (75,000)	0.00 (57,308)	0
H	87.84 (75,000)	97.84 (75,000)	+
I	0.00 (75,000)	0.00 (75,000)	0

EPA Sign Test: Observation of 1 '+' sign(s) in 2 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 75.00 percent significance level(b).
 (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	56.75 (75,000)	21.60 (64,365)	-
C	91.25 (75,000)	11.66 (75,000)	-
G	17.73 (61,634)	8.15 (54,158)	-
H	24.76 (66,770)	34.21 (2,599)	+
I	79.92 (75,000)	12.65 (53,361)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Maximum Percentage of Vehicles Failing Standard Test
 Using Proposed Clean Air Act Standards
 75,000 Mile Analysis
 (based on quadratic regression)
 Data Set ETHYL4S2
 Pollutant Carbon Monoxide

Model	Maximum Estimated Percentage Failures (mileage)(a)		Sign ('+' = adverse HT3 effect)
	EEE	HT3	
E	99.91 (75,000)	98.48 (61,672)	-
C	0.74 (49,354)	2.28 (49,603)	+
G	0.00 (56,940)	0.00 (65,372)	0
H	78.15 (59,770)	67.22 (65,448)	-
I	0.04 (75,000)	0.00 (55,896)	-

EPA Sign Test: Observation of 1 '+' sign(s) in 4 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 93.75 percent significance level(b).
 (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- For each mileage the percentage of vehicles failing the standard is estimated using the quadratic regression curve. The first figure is the maximum percentage over all mileages from 0 to 75,000 miles. The figure in parentheses is the mileage at which the maximum occurs.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
				C
C	.	.	.	-
G	.	.	.	-
H	32,000	29.34	29.51	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	47,000	0.08	10.08	+
G	.	.	.	-
H	39,000	75.98	76.04	+
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	.	.	.	-
G	11,000	9.55	10.05	+
H	0	32.81	73.26	+
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on linear regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	0	5.56	42.09	+
C	27,000	5.37	10.54	+
G	.	.	.	-
H	.	.	.	-
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials.)

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the linear regression line exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	38,000	51.56	51.88	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
 Using Proposed Clean Air Act Standards
 50,000 Mile Analysis
 (based on quadratic regression)
 Data Set ETHYL4S2
 Pollutant Non-Methane Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	40,000	79.20	79.28	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Nitrogen Oxides

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	0	28.74	59.11	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
50,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	0	7.54	14.70	+
C	22,000	6.07	10.19	+
G	.	.	.	-
H	.	.	.	-
I	.	.	.	-

EPA Sign Test: Observation of 2 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 81.25 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 50,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 6, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	37,000	8.50	10.24	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- a. If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.
- b. The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Non-Methane Hydrocarbons

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	31,000	13.92	14.05	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
 Using Proposed Clean Air Act Standards
 75,000 Mile Analysis
 (based on quadratic regression)
 Data Set ETHYL4S2
 Pollutant Nitrogen Oxides

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	.	.	.	-
C	.	.	.	-
G	.	.	.	-
H	0	5.81	34.12	+
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b). (For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
 April 9, 1990

Ethyl Corporation HiTEC 3000 Fleet Testing Program

Cause or Contribute Test
Using Proposed Clean Air Act Standards
75,000 Mile Analysis
(based on quadratic regression)
Data Set ETHYL4S2
Pollutant Carbon Monoxide

Model	First Mileage at which Failure to Meet Standards Is Caused (. = not caused)(a)	Percent Failures		Sign ('+' = adverse HT3 effect)
		EEE	HT3	
E	3,000	2.05	11.36	+
C	.	.	.	-
G	.	.	.	-
H	.	.	.	-
I	.	.	.	-

EPA Sign Test: Observation of 1 '+' sign(s) in 5 trials rejects the hypothesis of no adverse HiTEC 3000 effect at the 96.87 percent significance level(b).
(For the purpose of the sign test, only observations with sign = + or - are counted as trials).

Notes:

- If a number appears in this column then at this mileage, the percentage failures due to HiTEC 3000 estimated from the quadratic regression curve exceeds both ten percent and the estimated percentage failures due to EEE. The number that appears is the first mileage for which these conditions occur. A period appears if these conditions do not occur for any mileage up to 75,000 miles.
- The lower the significance level, the greater the evidence of an adverse HiTEC 3000 effect.

Systems Applications Inc.
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